R E P O R T R E S U M E S

ED 020 063 RC 002 515

PROGRAMMED MATHEMATICS, CLOUDCROFT HIGH SCHOOL.

BY- CLENDENIN, MARY JOE

NEW MEXICO WESTERN STATES SMALL SCHOOLS PROJECT

PUB DATE NOV 65

EDRS PRICE MF-$0.25 HC-$0.40 8P.

DESCRIPTORS- *ALGEBRA, *HIGH SCHOOLS, INDIVIDUALIZED PROGRAMS, MATHEMATICAL CONCEPTS, MATHEMATICS, *MODERN MATHEMATICS, MATHEMATICS INSTRUCTION, MATHEMATICS MATERIALS, PROGRAMED INSTRUCTION, *PROGRAMED MATERIALS, PROGRAMED TEXTS, PROGRAM EFFECTIVENESS, *SMALL SCHOOLS,

A PROGRAMED ALGEBRA 1 COURSE WAS OFFERED FOR THE THIRD YEAR TO STUDENTS OF THE CLOUDCROFT, NEW MEXICO, HIGH SCHOOL. ALL FRESHMEN (15), 4 SOPHOMORES, 1 JUNIOR, AND 2 SENIORS WERE ENROLLED. A SCHEDULE WAS DEVELOPED WHEREBY EACH STUDENT COULD COMPLETE THE ENTIRE 73-CHAPTER COURSE IN A SCHOOL YEAR. TEACHER-MADE TESTS WERE GIVEN AT THE END OF EACH CHAPTER AND WEEKLY GRADES WERE BASED ON THESE TESTS AND ON STUDENT PACING. AT THE END OF THE YEAR, 2 STUDENTS HAD COMPLETED THE ENTIRE PROGRAM AND ALL STUDENTS HAD COMPLETED AT LEAST 35 CHAPTERS. THE BIGGEST ADVANTAGE OF PROGRAMED INSTRUCTION WAS SEEN AS THE INDIVIDUALIZATION OF INSTRUCTION. (SF)

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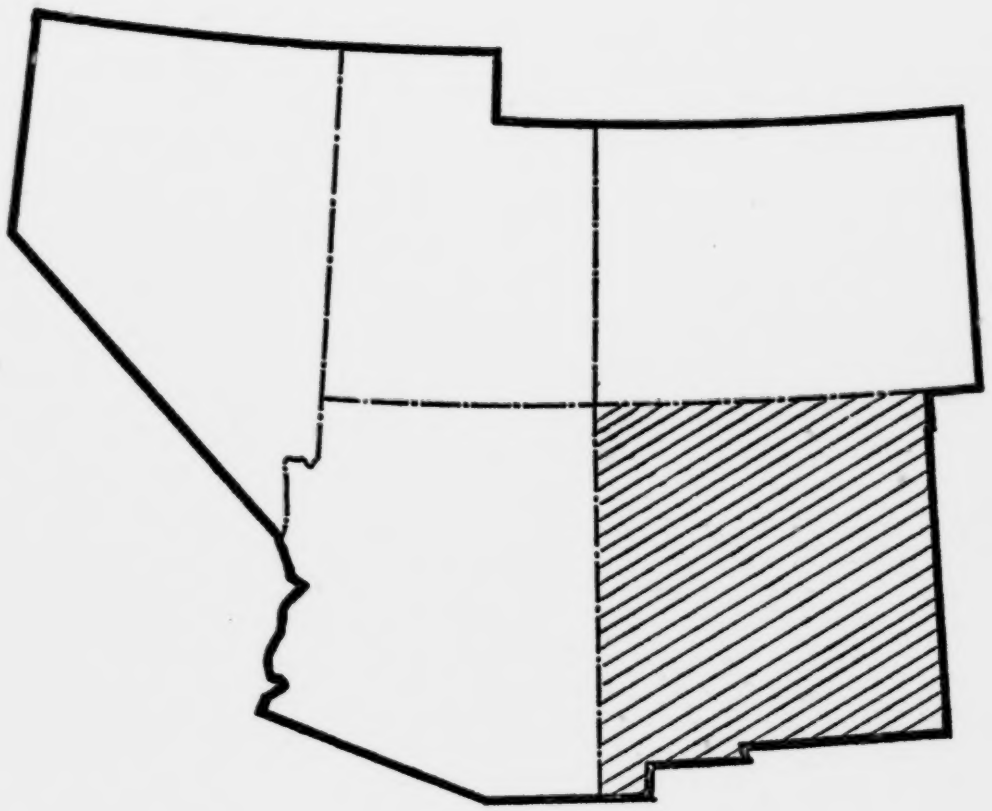
PROGRAMMED MATHEMATICS

CLOUDCROFT HIGH SCHOOL



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RC002515

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Foreword

The purpose of this publication is to assist administrators and teachers contemplating the use of prgrammed mathematics in their schools. We hope to assist by reporting the classroom experience of Mrs. Mary Joe Clendenin, high school mathematics teacher in the Cloudcroft Public Schools, Cloudcroft, New Mexico, with programmed mathematics.

This study was conducted under the auspices of the New Mexico Western States Small Schools Project, a project directed by the New Mexico State Department of Education and financed by the Ford Foundation.

The consultant for the study was Miss Lura Bennett, Specialist in Mathematics, New Mexico State Department of Education, who worked consistently with the teacher and students.

The evaluation of the teaching effectiveness of the programmed course was done by Dr. Henry Ellis, Associate Professor of Psychology, The University of New Mexico, Albuquerque.

DAN D. CHAVEZ
Project Director

Problems and Objectives

This section notes the general and specific problems. The general and specific objectives are also noted.

PROBLEMS

General:

The limitation of Cloudcroft's size limits the opportunity to offer various mathematics curricula.

Specific:

1. A small faculty
2. Difficult scheduling and limited course offerings
3. A number of small class enrollments
4. Providing for children of varying abilities
5. A restricted plant facility; teachers share common classrooms
6. Teachers' work loads preclude adequate time for planning and individualized instruction

OBJECTIVES

General:

It is our purpose to overcome some of the small school mathematics program limitations.

Specific:

1. To provide for advancement at students' own pace
2. To offer more individualized study
3. To provide for a variety of mathematics offerings during the same block of time
4. To provide an opportunity for the integration of traditional and modern mathematics
5. To increase community satisfaction with course offerings
6. To utilize consultant help in mathematics and physical science available at the Sunspot, New Mexico, Project
7. To utilize the visiting scientist program
8. To increase the quantity and type of mathematics units being taught

Programmed Mathematics: Organization and Administration

By MRS. MARY JOE CLENDENIN

This report is separated into sections regarding the programmed course used — organization and administration, testing, grading, chapters completed, general comments—and comments on programmed instruction.

Programmed Course Used

The programmed course used was *Modern Mathematics, Course* 1, published by Science Research Associates, Incorporated. It is a programmed course in updated Algebra, covering the introductory elements of traditional first year Algebra. The programmed course consists of 73 chapters; these are included in ten books.

Organization and Administration

The programmed course was used in an Algebra I class, which met for fifty-five minutes, five days per week. This was the third year the program had been used. All freshmen and some upper-classmen, who were either transfers or for some other reason needed Algebra I, were enrolled in the class. The class was composed of fifteen freshmen, four sophomores, one junior, and two seniors making a total of twenty-two members. Selection was not based on ability.

Usually, most of the class period was devoted to working on the program with the teacher helping individuals as the need arose. Sometimes when two or three students were having difficulty of the same type, the students were taken to the chalkboard for explanations and practice.

Twice during the year, we had visiting scientists lecture to the class. At the beginning of the year, the overhead projector was used to help explain set concepts. Later in the year, inverses and identity elements were demonstrated with the aid of the overhead projector. Rules for operation with signed numbers were duplicated, together with practice sets, and used as supplemental material. I felt this necessary because the text never gave these rules per se, and I felt the need for the students committing them to memory and having extra drill in their usage.

At the end of the first semester and again at the end of the last semester, a non-programmed book, *Algebra for Problem Solving,* published by Houghton, Mifflin Co., was issued and used for drill and review. I am not recommending this book. It was used because it was the book we had on hand, and for this purpose, it was adequate.

At the beginning of the year, we set up a schedule by which the student could complete the entire course in a school year's time. Even though one advantage of the program is that it enables individual progress, I have found some schedule necessary to keep the students from loafing. This schedule is flexible enough to allow for more time on the longer and more difficult chapters. When a student was up to schedule, he was allowed to go to the library during the class period upon request.

Chapter Tests

Teacher-made tests were given at the end of each chapter with 70 being a passing grade. When the student completed a chapter, he showed the teacher his work and requested a test. The test was then scored, usually during the class period, and if the student passed it, he went on to the next chapter. If not, he studied and repeated the test the next day.

I kept a record of the chapters completed and grades on a weekly calendar; thus, the progress of each individual student could be checked daily. This made it easier to know when the student needed encouragement, or prodding, or help.

Grading

Grades were based on both progress and test grades. The following system was devised for weekly grades. If the student took two chapter tests during the week with grades of 80 or above on each, he made an "A" for the week. Two tests with grades from 70 to 80, or one test with 90 or above earned a "B." One test with 70 to 90 earned a "C." No tests passed earned an "F" for the week. The reporting grade at the end of nine weeks was an average of these. If the student fell below schedule one week but came above the next, this was considered by averaging the two.

Final Test

Last year we spent about three days using the publisher's final as a pretest. But because only about three students scored at all, and they less

than five points, I considered it a waste of time. This year I arbitrarily gave each a '0' on the pre-test and then gave a teacher-made post-test at the end of the year.

This final teacher-made test was made up of sample problems from each of the 73 chapters in the course. There were 93 items on the test.

Chapters Completed

At the end of the year, two students had completed the program, which consists of 73 chapters. All the students, however, had completed at least 35 chapters.

General Comments

Next year I plan to use more supplementary material and more general-class sessions. Once a week, I will use duplicated work sheets and teacher lecture. In the review sessions this year, I have felt that the students went through the program without mastery; at least the mastery has not been as great as I would like for it to be.

This year's Geometry students and Algebra II students were in the program their freshman year. Their success in these higher courses has been average. In Geometry it is still necessary to teach much basic Algebra. Individual differences are perhaps a little more pronounced at this level than they would have been in a regular classroom situation.

Teaching the program this year was easier because I was more familiar with the content. It still is not an easy tool to use. The demands upon the teacher are great. When a student asks for help, the teacher must be able to aid him on the basis of what he has learned, and this is different at any step of the program. Class discippline can be difficult to maintain if the teacher is not aware of all individuals, even when she is helping a small part of the class. Freshmen, especially, do not voluntarily work independently.

Comments on Program

The program itself is quite broad in scope. The approach is modern with emphasis on understanding. One of the big advantages of the context is the usage and development of a mathematics vocabulary. This had been a shortcoming of high school and grade school mathematics programs. For example, we all were probably aware at one time of the arithmetic laws here demonstrated, but it is unlikely we learned them by name. We recognized "1" as the identity element for multiplication, but we were not on a "speaking acquaintance" because we did not know what to call it. We knew that 3/2 inverted was 2/3, but maybe we didn't acknowledge that the "operation" of multiplication was the "inverse operation" of division.

In several places, the program obfuscates a fairly simple concept. After the first two years of using the course, I learned to expect confusion in particular places. Usually these places were where the program attempted to over simplify.

Exponents are not introduced soon enough. Exponents, as such, are not introduced until Chapter 52. Many students do not get this far, and yet knowledge of this topic is assumed in any mathematics course beyond Algebra I. Had it not been for supplemental work, the majority of the class at the end of the year would not have been aware that $x \cdot x$ or xx equals x^2.

The student is not required to do a step-by-step solution in problem solving. Although the program leads him through, step-by-step, in many examples, the student is inept when on his own.

Factoring is not successfully presented. In trying to simplify factoring, the program, instead, confuses the student.

Graphing on the coordinate plane is unduly complicated. The location of points is really quite easy, but by calling the ordinate and the abscissa, columns and rows, respectively, the program introduces an unnecessary complication. Also, no clear cut rules for operations with signed numbers are presented.

The chapter tests are too sophisticated for high school students in general and for freshmen in particular. Sometimes the students may arrive at a correct answer which is not given in the multiple choice answers offered. Often the questions are not clear. Many times they require generalizations the student is not capable of making. A student could master the chapter in the text and fail the chapter tests. The chapter tests I made used sample problems of the same form as presented in the chapter, requiring the student to show much of his work. These tests are, of course, a little more difficult to grade.

Comments on Programmed Instruction

The biggest advantage of programmed instruction is the individualization of instruction. The slow student does not have to keep up with the faster students. The faster students are not detained by the slow students. But at best, programmed instruction is a teaching tool, not a substitute for the teacher.

Evaluation of Teaching Effectiveness of Modern Mathematics, Course 1

a. *School*: Cloudcroft
b. *Teacher*: M. J. Clendenin
c. *Program*: *SRA Modern Mathematics, Course I*
d. *Sample*: N = 24
e. *Summary Table of Results*:

	Pre-test	*Post-test*[1]	*Gain*
Mean	0	46.82	46.82*
S. D.	0	13.04	

*t = 16.84, df = 21, p < .01

f. *Gain Ratio*: .50
g. *Summary & Conclusions*:

Students learned a significant amount from the program as attested by an analysis of the learning data. The gain ratio revealed that students learned 50% of what they could possibly have learned. The assumption of a 0 pre-test score was made since these data were not available. According to Mrs. Clendenin, no student had a score larger than 5 on the pre-test, so this is a fairly reasonable assumption.

[1] The post-test score may have been considerably higher had all students finished the program. This post-test score is *un*adjusted and hence does *not* take into account this fact.

Appendix A, Letter to Parents

Cloudcroft School
October 17, 1965

Dear Parent:

You probably know by now that this is an experimental Mathematics program under which your student is working. It is experimental in that it presents some new material along with the usual Algebra I material, and that all the study is presented in a different manner.

We are convinced that this particular course, offered in this particular manner, can better serve *all* the students than could the traditional Algebra I. Your student will miss nothing that would be taught in a traditional Algebra I course. Instead, he is gaining all of that plus many new concepts.

The grades you find at this report period are not strictly an average of grades achieved on tests. Some students are going slowly and maintaining a better average than if they tried to keep up with others. The grade is indicative of progress, test grades, and class attitudes. Students are required to pass chapter tests before proceeding to the next chapter. Usually this means reviewing the chapter and then re-testing.

We are very optimistic about this course. We would appreciate your opinion or criticism. Any time you care to know more about this particular course, or any other, please feel welcome to talk with us about it.

Sincerely,

Mrs. Ray Clendenin, *Teacher*